name of the authority in every case. We commend this Appendix as quite a model of how much information may be conveyed in a few pages.

A second Appendix supplies a complete and partly synonymic catalogue of all the European Butterflies, amounting, as we said before, to 321 species. In his estimate of the number of species Mr. Kirby has wisely contented himself with following a good recent authority—Staudinger.

We must now leave the Butterflies of Europe in the hands of Mr. Kirby and his fellow entomologists. We trust that enough has been said to stimulate travellers to the contemplation, if not the capture, of *some* of the 321 species.

PROCEEDINGS OF LEARNED SOCIETIES.

ROYAL SOCIETY.

Nov. 20, 1862.—Major-General Sabine, President, in the Chair.

"On the Fossil Remains of a long-tailed Bird (*Archeopteryx macrurus*, Ow.) from the Lithographic Slate of Solenhofen." By Prof. Richard Owen, F.R.S.

The author details the circumstances connected with the discovery of the fossil remains, with the impressions of feathers, in the Lithographic slates of Solenhofen, of the Oxfordian or Corallian stage of the Oolitic period, and of the acquisition for the British Museum of the specimen which forms the subject of his paper.

The exposed parts of the skeleton are,—the lower portion of the furculum; part of the left os innominatum; nineteen caudal vertebræ in a consecutive series; several ribs, or portions of ribs; the two scapulæ, humeri, and antibrachial bones; parts of the carpus and metacarpus, with two unguiculate phalanges, probably belonging to the right wing; both femora and tibiæ, and the bones of the right foot; impressions of the quill-feathers radiating fan-wise from each carpus, and diverging in pairs from each side of the long and slender tail. The above parts indicate the size of the winged and feathered creature to have been about that of a rook. The several bones, with their impressions and those of the feathers, are described, and the bones are compared with their homologues in different Birds and in Pterodactyles. Whence it appears that, with the exception of the caudal region of the vertebral column, and apparently of a biunguiculate manus, with less confluent condition of the metacarpus, the preserved parts of the skeleton of the feathered animal accord with the ornithic modifications of the vertebrate skeleton. The main departure therefrom is in a part of that skeleton most subject to variety. Twenty caudal vertebræ extend from the sacrum in a consecutive and naturally articulated series, resembling in structure and proportions those of a squirrel. The tail-feathers are in pairs corresponding in number with the vertebræ, diverging therefrom at an angle of 45° backward, be-

coming more acute near the end, and the last pair extending nearly parallel with and $3\frac{1}{2}$ inches beyond the last caudal vertebra. This feathered tail is 11 inches long and $3\frac{1}{2}$ inches broad, with an obtusely rounded end. This novel and unexpected character of the tail is owing to the constancy with which all known existing and tertiary birds have presented the short bony tail with the terminal modification in most of them of the ploughshare bone.

Professor Owen next gives the results of investigations into the osteogeny of embryo birds, showing the number of vertebræ corresponding to the anterior caudals in *Archeopteryx* which coalesce with the pelvis in the course of growth, and the degree to which the posterior caudals retain a resemblance to those of *Archeopteryx* in the Birds with rudimental wings. From eighteen to twenty caudal vertebræ may be counted in the young Ostrich. In *Archeopteryx* the embryonal separation persists, with such continued growth of the individual caudal vertebræ as is commonly seen in long-tailed Vertebrates, whether Reptilian or Mammalian. The author remarks that the modification and specialization of the terminal bones of the spinal column in modern birds is closely analogous to that which converts the long, slender, many-jointed tail of the modern embryo fish into that short and deep symmetrical shape, with coalescence of terminal vertebræ into a compressed lamelliform bone, like the 'os en charrue' of birds, to which the term 'homocercal' applies—such extreme development and transformation usually passing through the heterocercal stage, at which, in palæozoic and many mesozoic fishes, it was arrested. Thus he discerns in the main differential character of the mesozoic bird a retention of structure which is embryonal and transitory in the modern representatives of the class, and consequently a closer adhesion to the general vertebrate type.

The least equivocal parts of the present fossil declare it to be a Bird, with rare peculiarities indicative of a distinct order in that class. Although the head is absent, the author predicts, by the law of correlation, a beak-shaped mouth for the preening of the plumage; and he also infers a broad and keeled sternum in correlation with the remains of feathered organs of flight.

The paper is accompanied by drawings of the fossil and its parts, and of homologous parts in Birds and Pterodactyles. The author assigns to the fossil animal the name of *Archeopteryx macrurus*.

Dec. 18, 1862.—Major-General Sabine, President, in the Chair.

"Description of a new Specimen of *Glyptodon*, recently acquired by the Royal College of Surgeons of England." By Thomas Henry Huxley, F.R.S., Hunterian Professor of Comparative Anatomy at the College.

In the present brief preliminary notice I propose to give an account of the more remarkable features of the skeleton of a specimen of the extinct genus *Glyptodon*, recently added to the Museum of the Royal College of Surgeons.

The specimen was obtained in 1860, by Signor Maximo Terrero, on

the banks of the River Salado, and was presented to the College by that gentleman, through the instrumentality of the late President of the College, J. F. South, Esq.

It arrived in England in an extremely broken and mutilated condition; but, by the exercise of great care and patience, Mr. Waterhouse Hawkins, to whom the President and Council of the Royal College of Surgeons entrusted the task of adjusting the scattered fragments, has succeeded in restoring to their natural condition the greater part of the vertebral column, the limbs, and much of the head. In the execution of this laborious undertaking Mr. Hawkins has had, from time to time, all the anatomical aid that Mr. Flower, the Conservator of the College Museum, and I could afford him; and the authorities of the College have finally entrusted me, as one of the Professors of the College, with the duty of describing the specimen.

This duty I propose to discharge by preparing a full description of the skeleton in a memoir to be presented (accompanied by a draught of the requisite illustrations) to the Royal Society. But as the preparation of such a memoir will require some time, I wish, at present, to lay before the Royal Society a preliminary account of those particulars in the structure of this animal which must interest anatomists in general as much as the special student of the fossil Edentata, in the hope that the notice may appear in the 'Proceedings' of the Society.

The mass of bony fragments which arrived from South America has afforded material for the reconstruction of the carapace, and of the following parts of the skeleton:—the anterior moiety of the skull with the entire palate; the mandible; some of the cervical, and the greater part of the dorsal, lumbar, sacral and coccygeal vertebræ, with vertebral and sternal ribs; the pelvis and the hind limbs; part of the scapula, and an entire fore limb. And there can be no doubt that all these remains belong to one and the same animal, as no duplicate bones have been discovered, nor any which there is the least reason to believe belong to a different individual. This circumstance gives a particular value to the present specimen, apart from the fact that, notwithstanding the researches of Professor Owen, of D'Alton, of Lund, and of Nodot, our knowledge of the structure of the anterior part of the skull, of the vertebral column and pelvis, and of the fore limb of *Glyptodon* and its immediate allies, is either nil or extremely imperfect. I now proceed to note the more important and the novel anatomical peculiarities which it reveals.

Of the *skull* the new specimen exhibits the anterior moiety, from the anterior boundary of the cranial cavity to the anterior end of the nasal bones, together with the almost entire bones of the face and the lower jaw; it thus furnishes a nearly complete supplement to the fragmentary cranium, consisting of the brain-case and the nasal bones, with the zygomatic processes, formerly described by Professor Owen as a part of *Glyptodon clavipes*, and now set up in the College Museum, together with a carapace, a tail, and a hind foot, as the typical example of that species*. In the form of the frontal bone, of the

* The parts thus combined together were not found so associated, and the

orbits, of the nasal bones, and of the zygomatic process, the skull of the new specimen agrees very closely with that of *Glyptodon clavipes*. From the slighter rugosity of the supraorbital region, the less development of the temporal ridges, and the fact that the nasal suture persists in the new specimen, I conceive it to have been a younger animal.

The anterior nasal aperture is trapezoidal, and narrower below than above. The vomer is very thick and strong, and the turbinal bones are well developed. The premaxillæ, though small slender bones, enter largely into the lateral boundary of the nasal aperture. Inferiorly they are separated in the middle line by a narrow fissure, which runs back into the crescentic anterior palatine foramen.

The maxillary bones are extremely elongated; while the palatine bones are small in proportion to them, and, like the premaxillæ, are separated by a very narrow median fissure. The extreme length of the roof of the palate, formed by these three pair of bones, is 10 inches; while its width (between the inner edges of the teeth), though rather greater in front than behind, nowhere exceeds $1\frac{3}{4}$ inch. From before backwards the palate has a double curvature, being concave downwards from the anterior end of the premaxilla to the level of the third tooth, and convex thence to the end of the palate-bones; so that the posterior part of the palate has a very marked inclination upwards and backwards.

There were eight teeth in each maxilla, all trilobed, the longitudinal grooves separating the lobes being less marked in the anterior teeth.

The mandible is represented by the two horizontal rami, with the symphysis, the greater part of the right coronoid process, and the entire right condyle, together with many of the sixteen teeth. It very closely resembles the mandibles of *Schistopleuron gemmatum*, described by Nodot, but is wholly unlike the restored jaw of *Glyptodon clavipes* given (on the authority of a drawing) by Professor Owen*.

The articular surface is situated almost wholly upon the anterior surface of the condyle of the mandible, looking but very slightly upwards; it is transversely elongated, slightly concave from side to side, and convex from above downwards. In all these respects it furnishes a counterpart to the glenoid articular surface of the temporal bone of *Glyptodon clavipes*, already described by Professor Owen.

The length of the head of the present specimen, when entire, was probably not less than 13 inches. The greatest depth of the cranium, from the centre of the frontal bone to the middle of the

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question may arise whether the skull, hind foot, and tail are really parts of the animal to which the carapace (on whose characters the species is founded) belonged. Provisionally I assume that they are. But so many difficulties are involved in the precise determination of the species of these extinct Armadillo-like Edentata, that for the present I leave the question open.

* The mandible of the Turin *Glyptodon*, mentioned at the end of this paper, is quite similar to that of the new specimen, and to that of M. Nodot's *Schistopleuron*.

palate, is about 6 inches ; the length of the mandible can hardly have been less than 12 inches.

Of the vertebral column, the greater part of the sacral and dorsal region, and some fragments of the cervical region, are preserved. The latter show that the atlas was distinct, but that the axis was anchylosed with one or two succeeding vertebræ, as in the Armadillos. The fifth and sixth cervical vertebræ were probably free, but no traces of them have been found. The anterior part of what remains of the rest of the vertebral column consists of a very broad flat bone, composed of three vertebræ firmly anchylosed together, and having their spinous processes represented by a short but very stout osseous knob, which projects upwards and backwards. Anteriorly, these anchylosed vertebræ exhibit on each side of the neural canal an articular facet with a convex surface, resembling a segment of a horizontal cylinder ; posteriorly, articular surfaces of a similar character, but concave, are situated in corresponding positions.

Each side of this 'trivertebral bone' presents two large and deep articular cavities for the heads of ribs, fragments of which are still preserved. The anterior rib, remarkable for its stout and massive proportions, was undoubtedly the first ; and this circumstance I believe gives a clue to the precise character of the vertebræ which are anchylosed together to form the trivertebral bone ; for in the Armadillos the head of the first rib is fitted into a deep fossa, formed partly by the last cervical, and partly by the first dorsal vertebra. Furthermore, the body and transverse processes of the last cervical vertebra in the Armadillos present articular facets of an essentially similar character to those observable on the anterior face of the bone under description* ; and, finally, the last cervical vertebra is practically immoveable upon the first dorsal in many Armadillos, while the two vertebræ are completely anchylosed together in the priodont Armadillo. I conceive, then, that this remarkable bone of the *Glyptodon* is formed by the anchylosis of the last cervical and first and second dorsal vertebræ.

Of the remainder of the spinal column thirteen consecutive vertebræ are preserved ; and all of these were immoveably united into one long continuous tunnel or arched tubular bridge of bone, a structure which is without a parallel among the Mammalian Vertebrata. Of these thirteen vertebræ, the four anterior are so completely anchylosed together, that the original lines of demarcation between them are hardly discernible. Persistent sutures separate the fourth from the fifth, and the latter from the sixth ; but all trace of the primitive distinction of the sixth and seventh is lost. The other vertebræ are separated by sutures which become coarser and less close posteriorly. In all but the first, second, third, eleventh, and thirteenth vertebræ, the parts representing the vertebral centra are broken away ; but where they persist, they are so similar that they were doubtless of similar form throughout. Each centrum is, in fact, a

* I may remark in passing, that all the cervical vertebræ of the Armadillos, from the third backwards, are articulated together by joints similar in principle of construction to those which connected together the trivertebral bone of *Glyptodon* with the vertebræ in front of and behind it.

comparatively thin bony plate, so curved as to form a segment of a hollow cylinder of much larger diameter in the front than in the hinder vertebræ, the sides of which pass superiorly into the arches of the vertebræ.

The foremost vertebra of the thirteen is as broad as the posterior part of the 'trivertebral bone,' and presents a couple of convex articular facets which articulate with the lateral articular concavities described above in that bone. The vertebræ rapidly narrow, however, until the fourth is not more than three-fifths as wide as the first, while it is proportionately deeper; and this increase of depth relatively to width goes on until in the thirteenth vertebra the spinal canal is deeper than it is wide.

The spinous processes of these vertebræ are all broken short off; but sufficient remains of their bases to make the following points clear.

The spinous process of the first is almost obsolete, being a mere ridge sloping back towards the second, with which it is continuous. This appears to have been necessary to afford the requisite play for the knob of the trivertebral bone in its movements of flexion and extension on the rest of the spinal column.

The spinous process of the second vertebra was long and thick, and probably somewhat high. It appears to have been completely distinct from the third, which was thinner, and was anchylosed with its successors (as far as that of the twelfth vertebra inclusive) into a long continuous crest. The apices of the spinous processes may, however, have been distinct. So much as is left of the base of this crest shows that it was thickest at the sixth and seventh vertebræ (of the thirteen), and that it became thinner both anteriorly and posteriorly.

The spinous process of the twelfth vertebra, forming the termination of the crest, appears to have ended in a free, thin, but rounded edge. What remains of the spinous process of the thirteenth vertebra, on the other hand, thins off anteriorly to a natural edge, which is inclined upwards and backwards. Posteriorly the spinous process becomes very thick and stout, and appears to have had a considerable height. It ends in a fractured hinder margin.

The broad wing-like plates which represent the coalesced transverse processes of the first, second, and third vertebræ of the thirteen, exhibit distinct articular surfaces for the capitula and tubercula of ribs. Further back, the natural edges of the apophysial ridges are broken away, up to the eighth vertebra. Here they are entire on the left side and broken on the right; but, curiously enough, the broken processes are higher than the entire ones, so that the transverse processes in this region of the body must have been asymmetrically developed. The thirteenth vertebra presents peculiarities which could only be made intelligible by a lengthened description, and by figures. The contours of the articular processes become first distinctly traceable at the posterior part of the eleventh vertebra. They are better marked at the posterior part of the twelfth, and at the anterior part of the thirteenth vertebra.

The nervous foramina are not intervertebral, but pierce the arches of the vertebræ throughout the series. In the thirteenth the outlet of the foramen is separated, by a longitudinal bar of bone, into an upper and a lower division.

The posterior part of the thirteenth vertebra is much injured, and does not adjust itself naturally to the anterior end of that part of the lumbar region of the vertebral column (consisting of two vertebræ) which remains continuously anchylosed with the sacrum. One or two vertebræ may possibly be wanting, or even three; but I conceive the last to be the extreme limit of the deficiency*.

The great Priodont Armadillo has twenty dorso-lumbar vertebræ. If the *Glyptodon* had the same number, there would be three missing; for there are two dorsal vertebræ in the trivertebral plate, thirteen follow it, and two lumbar are anchylosed with the sacral, making altogether seventeen.

The 'sacrum,' composed of anchylosed lumbar, proper sacral, and coccygeal vertebræ, contains at fewest twelve, and perhaps thirteen vertebræ. The centra of the two lumbar vertebræ and of the two proper sacral vertebræ which follow them are preserved. They are thin and broad plates, flat above and slightly concave below, exhibiting a most marked contrast with the half-cylinder of the hindermost of the thirteen dorsal vertebræ above described. It would seem to require the interposition of at least two, if not three, vertebræ to effect the transition of the one form of centrum into the other.

The last coccygeal is the only vertebra among all those preserved the centrum of which exhibits characters at all like those of an ordinary mammal, its terminal face being a very broad oval, slightly concave, disk. The centrum of the penultimate coccygeal is much flatter and narrower; and this flattening and narrowing predominates still more in the antepenultimate and that vertebra which lies before it, or the fourth from the end. From this point to the two anterior sacrals the floor of the vertebral canal is completely broken away, but there can be no doubt that the centra were represented by a thin bony plate.

The line of the centra of the coccygeal vertebræ forms a very marked arch behind the two sacral vertebræ, whose centra form a nearly horizontal floor; while the dorso-lumbar vertebræ (including the trivertebral bone) form a second arch, flatter than the first.

The spinous processes of all these lumbo-sacro-coccygeal vertebræ, up to the fourth from the end inclusively, are anchylosed together in a long and strong osseous crest, broad and extremely rugose above, eight inches high in front, but slowly diminishing as it follows the curve of the centra posteriorly to five inches.

The spinous process of the penultimate coccygeal vertebra is very thick, but is broken short off. It was probably not less than 4 inches high, and afforded a middle point of support for the carapace between the ischial protuberances. The sides of the median crest, and of the two vertebræ which appear to constitute the true sacrum, are anchy-

* Unless I greatly err in my interpretation of the photographs, these three missing vertebræ are preserved in the Turin *Glyptodon*.

losed firmly with nearly the whole of the inner edge of the vast ilium. Behind these the vertebræ seem to have been devoid of transverse processes, as far as the fourth from the end. But the antepenultimate had a long and slender transverse process on each side; the penultimate has an equally long but much stouter process, while the last coccygeal vertebra has transverse processes of no less length, and extremely stout.

The expanded distal ends of these processes unite with one another, and with the inner surfaces of the greatly expanded ischia.

The ilia are immense quadrate bones, slightly concave anteriorly and posteriorly, with their planes so directed as to form rather less than a right angle forwards with the vertebral column. The crest of each iliac bone is thick, expanded, and rugose, and so arched as evidently to have afforded attachment and support to the carapace; which therefore rested directly, partly on the three transversely disposed pillars afforded by the coccygeal vertebræ and the two ischia, partly on the longitudinally arched crests of the sacrum and of the thirteen dorsal or dorso-lumbar vertebræ, and partly on the second great transverse support yielded by the arched crests of the ilia. Apart from their anchylosis, the whole of the parts named must have been practically fixtures in consequence of this arrangement of the carapace; and the only moveable parts of the vertebral column must have been the tail (of which unfortunately no portion has been found in the present specimen), posteriorly moveable on the last coccygeal vertebra,—the trivertebral bone with its two pair of ribs, capable of an up-and-down motion on the foremost of the thirteen vertebræ,—and then the cervicals, more or less moveable upon the anterior part of the trivertebral bone and upon one another.

I am not aware of the existence of any mammal in which the vertebral column presents characters of a similar singularity.

The mobility of the rib-bearing trivertebral bone, by a hinge-joint upon the rest of the vertebral column, is peculiarly anomalous. However, if, as appears to have been the case, the heads of the ribs attached to this bone were incapable of movement, and the first rib was furthermore directly anchylosed with the sternum, respiration must have been carried on entirely by the diaphragm, if the anterior dorsal vertebræ had been immoveable on the posterior ones. The hinge-like movement of the trivertebral bone, on the other hand, by permitting the ribs and sternum to describe a longitudinal arc alternately downwards and forwards, and upwards and backwards, would allow of a most efficient bellows-action of the thorax, similar in principle to that effected by the ordinary movements of the ribs.

The trivertebral bone is about	6	inches long.
The thirteen vertebræ along their convexity ..	29½	,,
The sacrum	35½	,,
If three lumbar vertebræ are wanting allow ..	9	,,
	80	

Judging by the analogy of the Armadillos with which the *Glyp-*

todon presents such close resemblance, and from the shortness of such cervical vertebræ of *Glyptodon* as can be reconstructed, the neck did not exceed in length $\frac{1}{10}$th of the length of the vertebral column from the first dorsal to the last coccygeal. That would give 8 inches for the neck, and would give a grand total for the spinal column, exclusive of the tail, of 88 inches, or 7 feet 4 inches. The length of the carapace of *Glyptodon clavipes* in the Museum of the Royal College of Surgeons is 5 feet 7 inches.

The carpus of *Glyptodon* is in some respects very like that of *Dasypus sexcinctus*, but it consists of eight bones instead of seven, the trapezium and trapezoid being perfectly distinct, instead of forming a single bone as in *Dasypus*. The scaphoid articulates with the os magnum, and the cuneiform with a metacarpal, as in *Dasypus*. But it is not a little remarkable that, whereas in *Dasypus* it is the fifth metacarpal whose proximal end partially articulates with the cuneiform, in *Glyptodon* the corresponding bone articulated wholly with the cuneiform, and not with any of the distal row of carpal bones. The metacarpal articular end of that bone is, in fact, divided into two facets—an inner, larger, which articulates with part of the proximal end of the fourth metacarpal, and an outer, smaller, which is appropriated by the proximal end of the fifth metacarpal.

That the cuneiform should articulate with two metacarpal bones, and that the unciform should not articulate with the fifth metacarpal at all, are very remarkable peculiarities of the wrist of *Glyptodon*.

The pisiform is a large curved bone, the proximal end of which articulates by a large facet with the ulna, and by a small one with a facet on the palmar aspect of the cuneiform. It closely resembles the same bone in Armadillos.

The trapezium and trapezoid, taken together, have a form closely resembling that of the single trapezio-trapezoid of *Dasypus*. The trapezium possesses only a very small double articular facet on its palmar face. If this gives support to a metacarpal, it must have been very small; and as at present neither it nor any of the hallucal phalanges have been discovered, it is possible the pollex may have been altogether rudimentary. In any case the pollex must have been so much smaller and more slender in proportion than that of *Dasypus*, that the animal must have had a practically tetradactyle fore foot.

The second metacarpal is the longest of all which have been discovered, but is not quite so thick as the third. Its proximal end articulates with the trapezium, trapezoid, and magnum.

The third metacarpal, an almost cuboidal bone, but broader than long, articulates with the magnum, the cuneiform, and the adjacent metacarpals.

The fourth metacarpal, still shorter and broader in proportion, articulates with the unciform and cuneiform, and with the adjacent metacarpals.

The fifth metacarpal has not been found. The two proximal or first and second phalanges are very short, broad, discoidal bones in the second and in the third digits; and the second, which alone exists,

in the fourth digit has the same character. The proximal phalanges of the fifth digit have not been found.

The distal or third phalanx is a broad bone, squarely truncated at the extremity, and longer than the rest of the digit, in the second, third, and fourth, and presumably in the fifth digit. Each of these phalanges is thicker on one side than on the other, so that the upper surface, which is convex from side to side, and also from before backwards, slopes from the thick towards the thin edge.

The distal phalanx of the second digit has its thick edge on its ulnar side, but all the others have their thick edges radial. The distal phalanx of the fifth digit is more pointed, smaller, and thicker in proportion than the others.

The hind foot is quite normal in structure, possessing five toes and the regular number and disposition of tarsal, metatarsal, and phalangeal bones. The third or middle digit is the longest, and its distal phalanx is the longest of all. It is nearly square, and its outer and inner edges are almost equally thick. The distal phalanges of the other toes are all thicker on the side turned towards the middle toe. That of the second toe is almost as square as that of the third; but the distal angles of that of the third and fourth are bevelled off on the fibular side, while the terminal phalanx of the hallux is similarly bevelled off upon the tibial side. The metatarsal bones have the same thick prismatic form, and the proximal phalanges the same discoidal character as in the fore foot.

The calcaneal process is directed outwards at an angle of 45° from the axis of the foot, and must have been much raised in the natural position.

While the work of restoration, whose results have just been briefly detailed, was going on, we learned from Dr. Falconer that a nearly entire specimen of a *Glyptodon* was exhibited in the Museum at Turin. An application was at once made to the authorities of the Museum for information, and, if possible, for photographs of this skeleton, and was responded to with the most obliging readiness.

These photographs of a skeleton in some respects more, in others less perfect than that of the College, have confirmed the conclusions already arrived at in the most satisfactory manner; and I trust before long to be in possession of descriptive details of parts of this specimen which are wanting in our own, and which will enable me to complete the anatomy of the skeleton of the gigantic extinct Armadillo.

ZOOLOGICAL SOCIETY.

June 10, 1862.—Professor Busk, F.R.S., in the Chair.

List of Mammalia from the Camaroon Mountains, collected by Capt. Burton, H.M. Consul, Fernando Po. By Dr. J. E. Gray, F.R.S.

Crocidura morio, sp. nov.

Uniform rather brownish black, rather paler and browner beneath.